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Reduced plasma fibrinogen, serum peroxides, lipids, and apolipoproteins after a 3-week vegetarian diet

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Abstract. The influence of a 3-week vegetarian diet and fasting on serum concentration of peroxides, lipids, apolipoproteins, and plasma fibrinogen was studied in ten middle-aged fibromyalgia/fibrositis patients (eight women, two men). Mean serum peroxide concentration (estimated as thiobarbituric acid reacting substances) was reduced from 3.60 ± 0.14 to 2.82 ± 0.15 umol/l ($p = 0.01$) and plasma fibrinogen from 3.33 ± 0.25 to 2.74 ± 0.15 g/l ($p = 0.02$). Serum total cholesterol fell from 6.61 ± 0.50 to 4.83 ± 0.35 mmol/l ($p < 0.0001$), apolipoprotein B from 1.77 ± 0.14 to 1.31 ± 0.11 g/l ($p < 0.0001$), and apolipoprotein A from 1.41 ± 0.09 to 1.23 ± 0.05 g/l ($p = 0.03$). High density lipoprotein cholesterol concentration also decreased somewhat (from 1.26 ± 0.09 to 1.07 ± 0.04 mmol/l, $p = 0.03$) An atherogenic index, reflecting the balance between low and high density lipoproteins, was reduced by 31% (from 5.74 ± 0.79 to 3.97 ± 0.60, $p = 0.02$). The results suggest that vegetarian diet/fasting may have a beneficial influence on the concentration of serum peroxides and plasma fibrinogen concentration, and on the serum level of several lipoprotein-related coronary risk factors.

Introduction

Epidemiological studies have shown that increased plasma fibrinogen concentration is strongly and positively associated with myocardial infarction and stroke [1].

We earlier reported that supplementation of the diet with fish oil reduced plasma fibrinogen levels in healthy middle-aged men [2]. Others have recently reported that the fibrinogen reduction by fish oils was dependent upon the presence of sufficient amounts of vitamin E, and that this vitamin prevented the rise in malondialdehyde [3], which is a peroxidation product of the high amounts of n-3 polyunsaturated fatty acids in the fish oil diet.

Peroxide formation seems to be of significance in the pathogenesis of

several diseases. Increased serum levels of peroxides have been found in both ischaemic heart disease and peripheral vascular disease, as well as in preeclampsia [4, 5].

Prevention of peroxide formation requires antioxidants. Natural antioxidants are supplied by the diet, e.g. beta-carotene, selenium, coenzyme Q, ascorbic acid, and vitamin E. Since peroxides seem to play a key role in disease development, and antioxidants are abundant in vegetarian foods, we have studied serum peroxide concentration before and after a 3-week vegetarian diet. We also included determination of plasma fibrinogen (which seems to be influenced by peroxides), and other atherosclerosis-related coronary risk factors, such as total- and HDL-cholesterol (TC, HDLc), apolipoprotein A and B, and triacylglycerols. Finally an atherogenic index, (TC-HDLc)* (apo B)/(HDLc)* (apo A), reflecting the balance between low and high density lipoprotein was calculated. We previoulsy reported [6] that this index had a closer relationship than individual lipoprotein to the extent of coronary atherosclerosis (assessed by number of stenosed arteries).

Materials and methods

Subjects

The study population consisted of eight women and two men who had the diagnosis fibrositis/fibromyalgia. Mean age was 49.9 $\pm$ 4.1 years, and body weight 89.0 $\pm$ 5.1 kg. Mean systolic and diastolic blood pressures were 134 $\pm$ 10 and 89 $\pm$ 5 mm Hg, repectively. Mean body weight fell significantly by 6.1 kg during the treatment, whereas systolic and diastolic blood pressures remained virtually unaltered.

All ten patients were put on a vegetarian diet. Three women and one man underwent fasting for 8-10 days as part of the therapy. Some physical activity (mostly walking) was part of the daily routine for the two men and for five of the women. At the end of the treatment period the two men and five of the women reported increased subjective wellbeing. For the remaining three women the situation was practically unchanged.

Blood sampling and determination of risk factors in blood.

Blood samples were taken after an overnight fast, and serum and plasma were kept at -20 °C prior to analysis of risk factors. Serum peroxides were estimated to thiobarbituric acid and reacting substances (TBARS), mainly

malondialdehyde [7]. No freezing and thawing was performed before determination of TBARS. Fibrinogen was determined in citrated plasma as thrombin coagulation time [8]. Total serum cholesterol, HDLc and triacylglycerols were determined enzymatically using Boehringer kit reagents. Apolipoprotein A1 and apolipoprotein B were estimated by turbidimetric determination, using Behring Turbitmer (Behringwerke AG, W. Germany). Appropriate standards obtained from the manufacturer were included. The 'atherogenic index' [6] was calculated as (TC-HDLc)* (apo B)/ (HDLc)* (apo A1).

Statistical analysis

Results are presented as mean ± SEM. Differences between mean values before and after the vegetarian diet were evaluated with the paired Students t-test, using SPSS and a personal computer. The level of significance was chosen to be $p < 0.05$, unless otherwise specified.

Results

Peroxides, fibrinogen, total cholesterol and HDL-cholesterol

Individual risk factor responses to a 3-week vegetarian diet are shown in Figs. 1 and 2. A considerable fall in serum peroxide levels (estimated as TBARS) was noted in eight subjects, whereas peroxides increased in two. Mean serum peroxide concentration (as estimated by TBARS) fell from a starting value of 3.60 ± 0.14 (mean ± SEM) umol/l to 2.82 ± 0.15 umol/l (Fig. 1, top).

Plasma fibrinogen concentration decreased in all but one of the patients. Mean concentrations before and after the treatment were 3.33 ± 0.25 and 2.74 ± 0.15 g/l, respectively.

In all subjects there was a decrease in serum total cholesterol (TC, Fig. 1, lower panel). Mean fall was from 6.61 ± 0.50 to 4.83 ± 0.35 mmol/l. The decrease in TC was positively correlated with weight reduction ($r = 0.703$, $p = 0.02$). There was also a significant fall in mean HDL-cholesterol concentration, from 1.26 ± 0.09 to 1.07 ± 0.04.

Apolipoproteins, triacylglycerols and 'atherogenic index'

Apolipoprotein B fell by 26%, i.e. from 1.77 ± 0.14 to 1.31 ± 011 g/l (Fig. 2, top). A smaller (13%) reduction was observed in apolipoprotein A (from

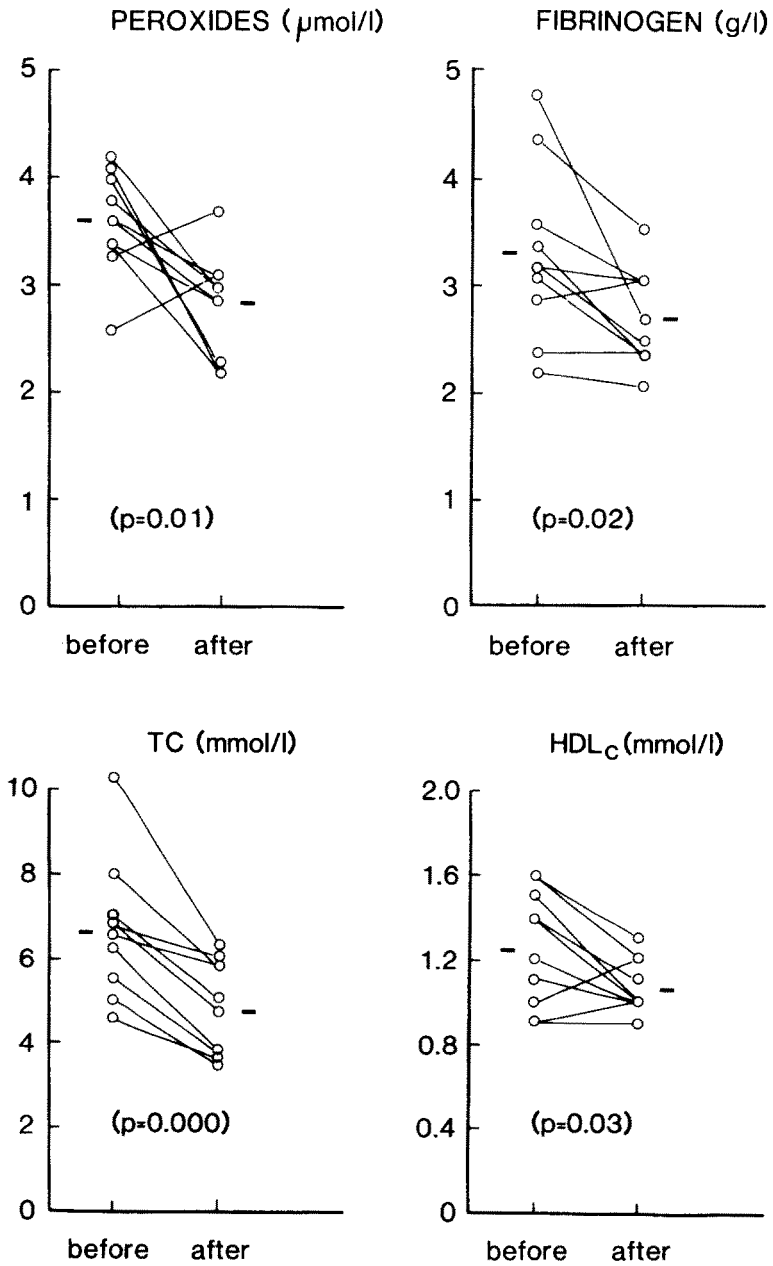

Fig. 1. Serum peroxides, plasma fibrinogen, serum total cholesterol (TC) and high density lipoprotein cholesterol (HDLc). The blood variables were determined in 10 fibromyalgia/fibrositis patients before and after a 3-week vegetarian diet. Individual responses. Mean values are indicated by horizontal lines. Significance levels (before vs after treatment, Students paired t-test) are shown.

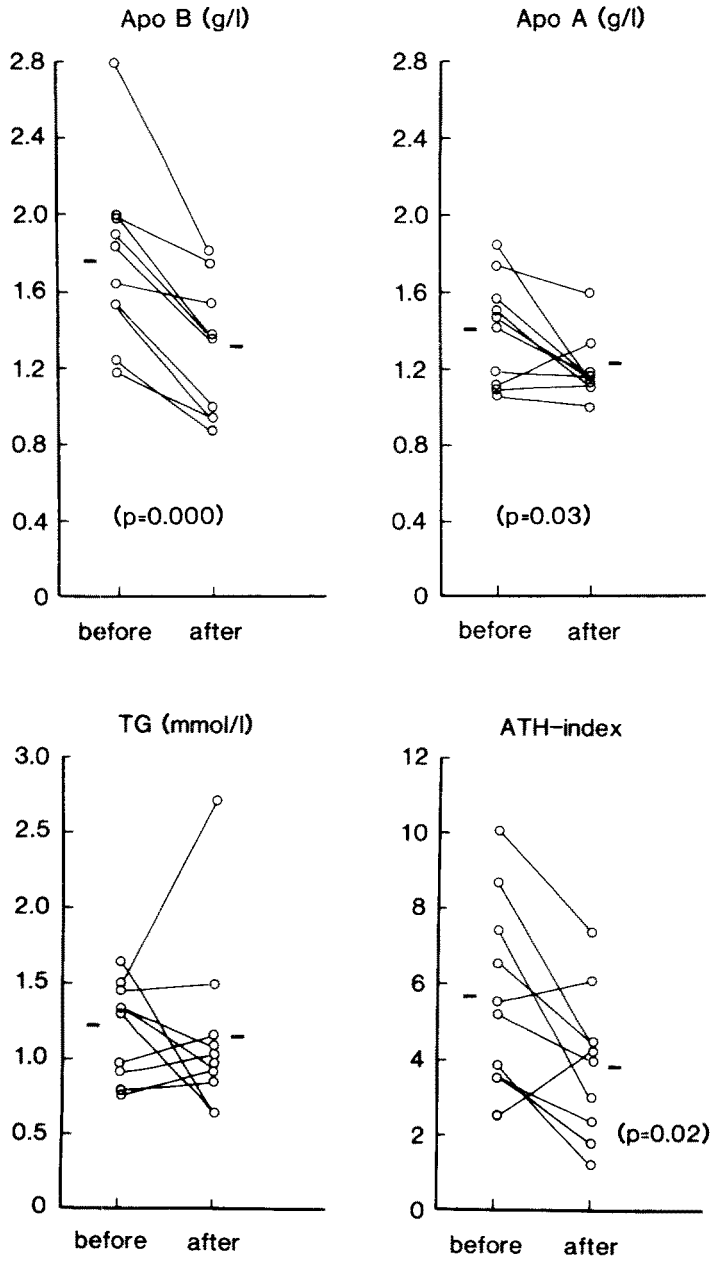

Fig. 2. Serum apolipoprotein B and A, triacylglycerols (TG) and 'atherogenic index' (ATH-index). The blood variables were determined in 10 fibromyalgia/fibrositis patients before and after a 3-week vegetarian diet and fasting. Individual responses. Mean values are indicated by horizontal lines. ATH-index is defined in text. Significance levels (before vs after treatment, Students paired t-test) are shown.

1.41 ± 0.09 to 1.23 ± 0.05 g/l). In contrast, there was no significant alteration in mean serum triacylglycerol concentration. Mean 'atherogenic index' was reduced by 31%, from 5.74 ± 0.79 at start to 3.97 ± 0.60 at the end of the treatment. This index was appreciably reduced in 8, but increased in 2 of the subjects.

Discussion

To our knowledge this is the first report showing that serum peroxide and plasma fibrinogen concentration can be reduced by a vegetarian diet (in combination with fasting and physical activity). In addition, the results confirm that this regime also has a beneficial influence on several other variables related to atherosclerotic diseases. The relative influence of diet, fasting and physical activity on the variables measured cannot be decided from the present results. The patients were told to practice some form of physical activity (mostly walking) which might have had a favourable influence on the lipid profile [9, 10]. It seems likely, however, that the lowering of serum peroxides and plasma fibrinogen can be largely attributed to a high content of antioxidants (e.g. beta-carotene, vitamin C and E) in the vegetarian food. The beneficial influence of the food on serum lipids can be explained by the low fat content of the diet.

Of interest from a clinical point of view is the positive effect of the treatment upon pain status of most of the patients. However, the improved condition of the fibromyalgia/fibrositis patients in the course of treatment with a vegetarian diet do not clarify whether the measured serum peroxides were related to their symptoms.

The atherogenic index, reflecting the balance between low and high density lipoproteins (LDL, HDL), was previously shown to be more closely associated with the extent of coronary atherosclerosis (assessed by number of stenosed arteries) than individual lipoprotein components [6]. The appreciable reduction of this index in response to the treatment is therefore of particular interest. Conceivably, the level of HDL is reduced when the requirement for centripetal cholesterol transport is reduced. In keeping with this, the components of serum high density lipoproteins, HDL- cholesterol and apolipoprotein A were also reduced by the vegetarian diet/fasting regime. However, the fall in HDL components was smaller than the fall in components mainly associated with low density lipoproteins (apo B and total cholesterol), thereby explaining a decrease in the atherogenic index.

In conclusion, following a 3-week vegetarian diet serum peroxide,

atherogenic lipid and apoliprotein concentrations, as well as plasma fibrinogen levels were reduced in fibromyalgia/fibrositis patients.

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